

## **Multivariate Curve Resolution of Nuclear Magnetic Resonance Spectroscopy Metabonomic Data**

M. Kathleen Alam

Sandia National Laboratories, Department of Biomolecular Analysis and Imaging

(505) 845-9621

mkalam@sandia.gov

**Authors:** M.K. Alam<sup>1</sup>, T.M. Alam<sup>1</sup>, D.R. Ekman<sup>2</sup>

<sup>1</sup>Sandia National Laboratories, Albuquerque, NM

<sup>2</sup>U.S. EPA Office of Research and Development (ORD)/National Exposure Research Laboratory (NERL), Athens, GA

**Keywords:** metabonomics, chemometrics, NMR, multivariate, MCR

A focus for the U.S. Environmental Protection Agency (U.S. EPA) Office of Research and Development's (ORD) Computational Toxicology (CompTox) research program is the use of "omic" tools as early indicators of exposure and effects due to anthropogenic chemicals. For example, the U.S. EPA/ORD/NERL will develop and apply advanced analytical techniques (e.g., nuclear magnetic resonance (NMR) spectroscopy) to observe changes in endogenous metabolites in biofluids (e.g., urine) that result when test animals (e.g., rats, fish) are exposed to test chemicals (e.g., pesticides). This approach, called metabonomics, is one of the newest and most powerful omic tools. Specifically, changes in concentrations of these natural metabolites (e.g., betaine, creatine, lactate, glutathione) will result in changes in NMR spectra over time. Perhaps the most critical aspect of this approach is the computational challenge of correlating observed spectral changes with exposure events. Sandia National Laboratories is working with the U.S. EPA to evaluate and develop mathematical tools for analysis of the collected NMR spectroscopy data. Initially, we have focused on the use of Multivariate Curve Resolution (MCR), also known as molecular factor analysis (MFA), a technique used for pattern recognition and identification of chemical components. We will present results from the analysis of simulated data in order to assess the performance of MCR under several conditions. Additionally, NMR data from the U.S. EPA for sera samples collected from rats that were exposed to conazole fungicides were also analyzed and will be presented. The MCR classification of fungicide toxicity will be compared to standard NMR metabonomic analysis techniques. These results demonstrate the importance of developing computational tools in conjunction with experimental verification in analyzing NMR metabonomic data. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.